Conceptual Category: Functions Content Standards [F]

Interpreting Functions F-IF

A. Understand the concept of a function and use function notation.

1. ~~Understand~~ Explain that a function is a correspondence from one set (called the domain) to another set (called the range) that assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

   For example, given a function representing a car loan, determine the balance of the loan at different points in time.
3. ~~Recognize~~ Demonstrate that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

   For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ for $n \geq 1$.

B. Interpret functions that arise in applications in terms of the context (linear, quadratic, exponential, rational, polynomial, square root, cube root, trigonometric, logarithmic).

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ★

   For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ★

C. Analyze functions using different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★
   a. Graph linear and quadratic functions and show intercepts, maxima, and minima. ★
   b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ★
   c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. ★
   d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ★
   e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. ★
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
   a. Use the process of factoring and/or completing the square in quadratic and polynomial functions, where appropriate, to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
   b. Use the properties of exponents to interpret expressions for exponential functions. Apply to financial situations such as identifying appreciation and depreciation rate for the value of a house or car some time after its initial purchase. $V_n = P(1+r)^n$

   For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, and $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay, including radioactive decay.

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9. ~~Translate among different representations of functions~~ Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
   For example, given a graph of one polynomial function (including quadratic functions) and an algebraic expression for another, say which has the larger/smaller relative maximum and/or minimum.
10. Given algebraic, numeric and/or graphical representations of functions, recognize the function as linear, quadratic, exponential, polynomial, logarithmic, trigonometric or rational (+).

Note: only changes to 2017 Massachusetts standards are included here. Others standards would be left as written.

2017 Massachusetts Standard, unless otherwise noted.	Changes, etc. This is how it looks according to Kerby's edits.	Thinking, or explanation
F-IF A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a....	F-IF A.1 ~~Understand~~ Explain that a function is a correspondence from one set (called the domain) to another set (called the range) that assigns to each element of the domain exactly one element of the range. If f is a....	"Explain" indicates performance "Correspondence" provides clarification From Colorado, changes to Idaho and Mass
F-IF A.2 No Example	F-IF A.2 For example, given a function representing a car loan, determine the balance of the loan at different points in time.	Example Mass added
F-IF A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	F-IF A.3 ~~Recognize~~ Demonstrate that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	"Demonstrate" indicates performance. From Colorado, changes to Idaho and Mass
F-IF A.4 Key features include: intercepts...	F-IF A.4 *Key features include: intercepts*	This section changes to be in *italics,* to show they are explanatory to the standard. From Colorado, changes to Idaho and Mass
F-IF A.8 example ..... and classify them as representing exponential growth or decay.	F-IF A.8 example ..... and classify them as representing exponential growth or decay, including radioactive decay.	Give the example an Idaho flavor, making it more relevant to our teachers, parents, and students.
F-IF A.9 Translate among different representations of functions (graphically, numerically in tables, or by verbal descriptions). Compare properties of two functions each represented in a different way.	~~Translate among different representations of functions~~ Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	Go back to the way Idaho's standard reads at present. Colorado left it like that as well.
F-IF A.10 No standard presently in Idaho. This standard is presently in Mass.	F-IF A.10 Given algebraic, numeric and/or graphical representations of functions, recognize the function as linear, quadratic, exponential, polynomial, logarithmic, trigonometric or rational(+).	New standard Mass and Colorado are using, and adding linear and quadratic.